PreCam 2.0 Survey Strategy and Requirements

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DES Collaboration Meeting

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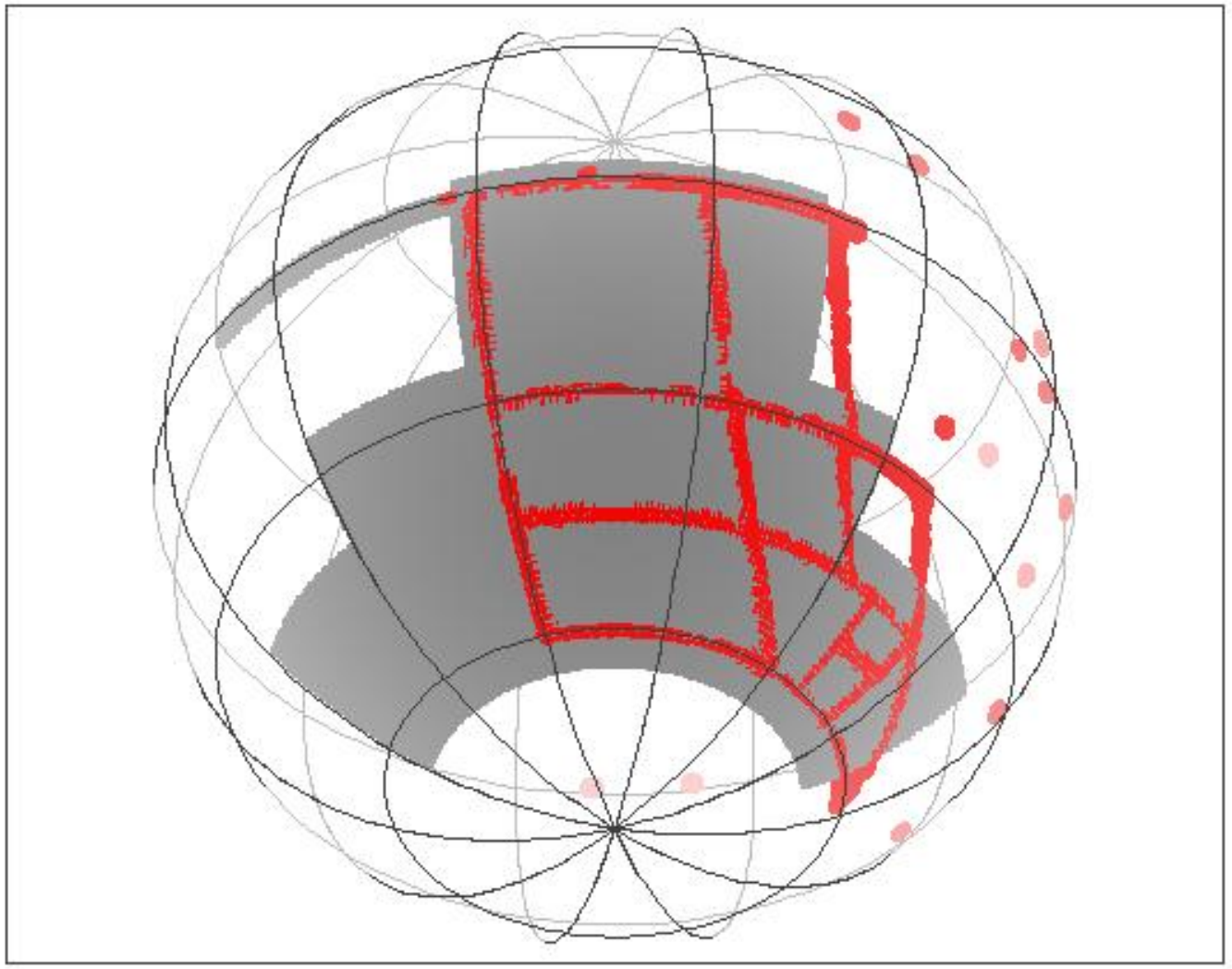
DARK ENERGY
SURVEY

i. Grid to Match Updated DES Footprint

PreCam 1.0 Standard Stars and the New DES Footprint

DARK ENERGY SURVEY

PreCam i (2%) Standard Stars and the New DES Footprint



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ii. PreCam Tilings to Reach Precision Goals

+

iii. Exposure Times & Overlap with DECam Dynamic Range

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The Equation

$$S/N = N_* / sqrt(N_* + N_{sky})$$

where

N_* and N_{sky} are in # of detected electrons.

(Readnoise and dark current are ignored.)

(From DES-doc-6529)

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Original Estimates (2009)

Baseline PreCam Survey Point-Source Magnitude Limits (optimized to achieve S/N=50 at DES saturation + 1.5mag)

Band	Exposure time [seconds]	PreCam saturation limit	PreCam mag limit S/N=50	Number of usable stars per sq deg (SGP)
g	36	12.8	17.8	186
r	51	13.2	17.8	265
i	65	13.4	17.7	344
z	162	14.1	17.5	317
Y	73	11.6	14.3	150

For PreCam 1 we tried to reach the PreCam S/N=50 mag limit in a *single* exposure. Catalog coaddition would provide contingency (which we needed in the end.

(From DES-doc-6529)

PreCam Exposure Time Estimates: Original Estimates vs. Measured Values

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Baseline PreCam Survey Point-Source Magnitude Limits (optimized to achieve S/N=50 at DES saturation + 1.5mag)

Band	Exposure time [seconds]	PreCam mag limit S/N=50 (Predicted)	PreCam mag limit S/N=50 (Measured)
g	36	17.8	16.6
r	51	17.8	16.7
i	65	17.7	16.4
z	162	17.5	16.3
Y	73	14.3	14.7

FNAL V3 processing

Should have been 15.9!
(See, e.g., DES-doc#3091)

(From DES-doc-6529)

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Differences from Original PreCam 1 Calculations

1. Used measured star counts and sky background counts from PreCam 1 images.

2. Used more realistic values for FWHM of images (3 arcsec) and photometry extraction aperture size (10 arcsec diameter).

3. Assumed a fractional illumination of $F_{illum} = 0.50$ for the original Curtis-Schmidt folding flat mirror.

4. Assumed a fractional illumination of $F_{illum} = 0.75$ for a new Curtis-Schmidt folding flat mirror.

Total Exposure Times for a PreCam 2
(with F_{illum}=75%)

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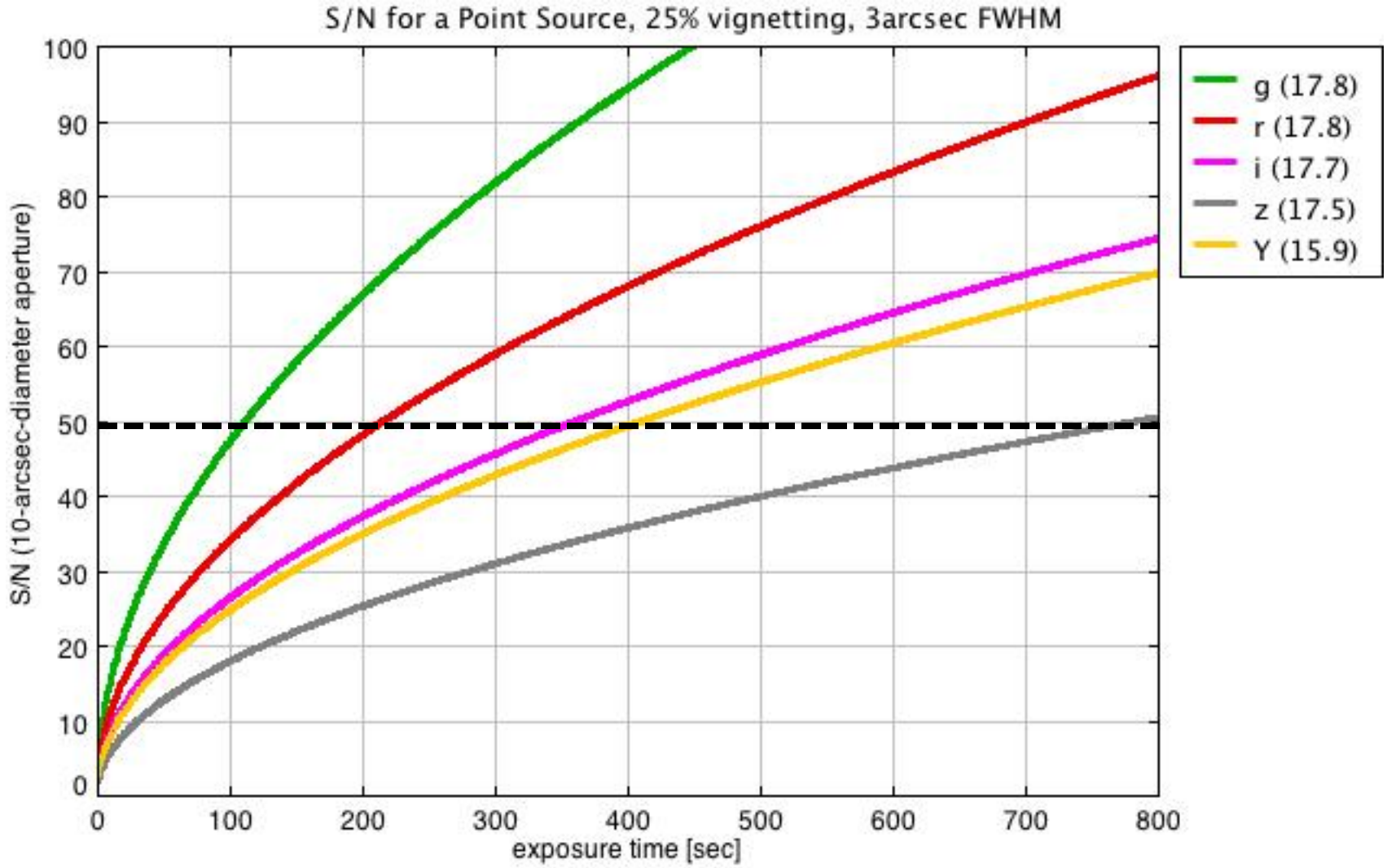
Band	Exposure time (Total) [seconds]	Exposure time (Individual exposure) [seconds]	PreCam mag limit S/N=50 (Final)
g	115	12	17.8
r	220	22	17.8
i	360	36	17.7
z	790	80	17.5
Y	415	42	15.9

For PreCam 2, the goal from the start is to reach the PreCam S/N=50 mag limit after *multiple* exposures, (after coaddition). Here, we assume a total of 10 exposures in each filter for each place in the PreCam footprint.

Here, the contingency is in assuming Fillum=75% instead of 100%.

Total Exposure Times for a PreCam 2
(with F_{illum}=75%)

DARK ENERGY SURVEY



Estimated Time to Complete a PreCam 2

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- Individual exposure times of (12, 22, 36, 80, 42) sec for (g, r, i, z, Y).
- Readout time: 20 sec
- Filter change: 10 sec
- Focus change: 10 sec
- Slew time (ave): 30 sec (pessimistic)
- Observe each field 10x (except where already adequately covered by PreCam 1)
- One grizY pointing = 12+22+36+80+42 + 5x(20+10+10) + 30 = 422 sec.
  - Comparable to, but shorter than, PreCam 1 pointing of 467 sec.
- PreCam 1 ran for about 60 nights of operations.
- We are probably about half finished with the 30° PreCam grid.
- **Another 60 nights of operations(?), plus time for commissioning?**

(See also Section 4 of DES-doc#3578 (PreCam 1 time estimates).)

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Extra Slides

Measured Depth of PreCam Data: S/N vs. Magnitude

(10-arcsec-diameter Aperture Magnitudes)

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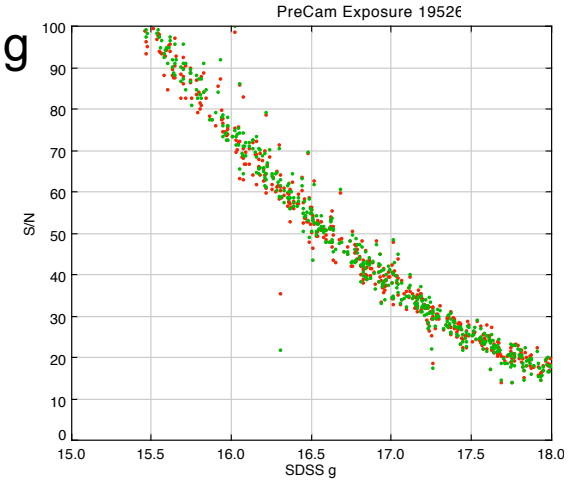
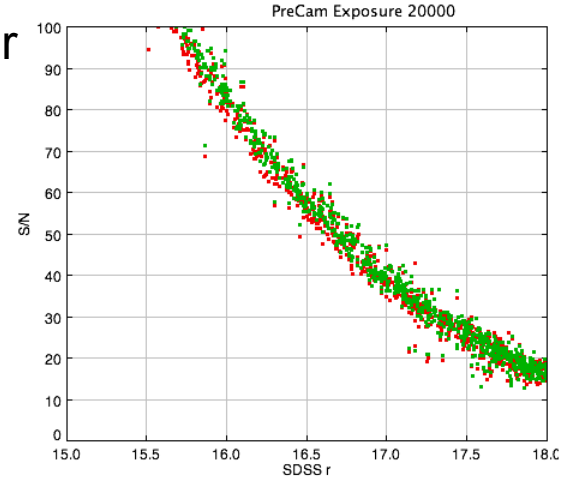
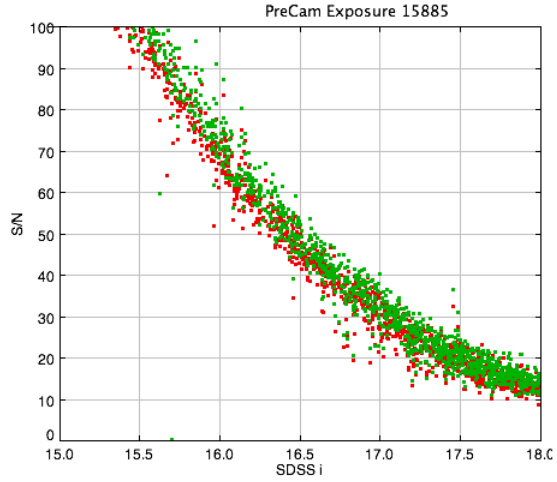
g



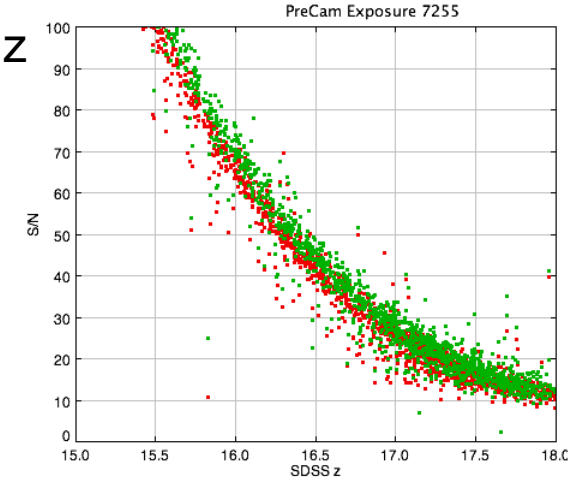
r



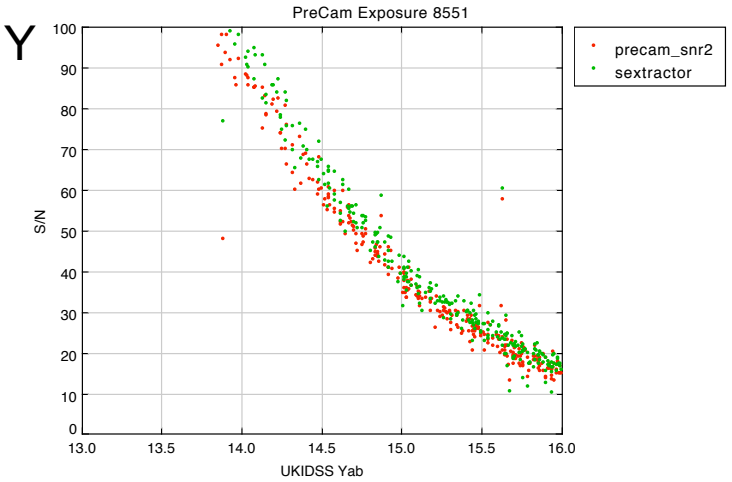
i



z



Y



FNAL V3 processing

(From DES-doc-6529)

Count rates: DES (Blanco+DECam)

(From DES-doc-3091)

DARK ENERGY SURVEY

mag=20 object		Sky Background		
Filter	e-/sec	Filter	mag/arcsec^2	e-/sec/pixel
g	584.56	g	21.7	8.8
r	586.25	r	20.7	22.3
i	542.49	i	20.1	35.9
z	394.44	z	18.7	95.0
Y	93.67	Y	18.0	43.1

For a mag=20 point source:

+ Multiply the “mag=20 object” count rate by 0.93738 for an aperture of radius = 1.0 FWHM (0.9 arcsec for DES).
+ Multiply the “mag=20 object” count rate by 0.07695 for an estimate of the count rate in a single pixel (assuming the point source is centered on the pixel’s center). This is useful for saturation limit estimates. Note that this fractional value is different than that for the PreCam exposures.

DARK ENERGY SURVEY

Count rates: PreCam

(Updated from DES-doc-3091)

mag=20 object			Sky Background		
Filter	e-/sec	meas'd	Filter	mag/arcsec^2	e-/sec/pixel	meas'd
g	13.21	6.35	g	21.7	5.6	2.9
r	13.25	6.35	r	20.7	14.1	6.8
i	12.26	5.90	i	20.1	22.8	12.7
z	8.92	5.50	z	18.7	60.2	36.8
Y	2.12	1.75	Y	18.0	27.3	36.6

~50% of expected (griz)

For a mag=20 point source:

+ Multiply the "mag=20 object" count rate by ~~0.93738~~ **0.99955** for an aperture of radius = ~~1.0 FWHM~~ **1.67** (~~2.0~~ **3.0** arcsec for PreCam).
+ Multiply the "mag=20 object" count rate by ~~0.37968~~ **0.19022** for an estimate of the count rate in a single pixel (assuming the point source is centered on the pixel's center). This is useful for saturation limit estimates. Note that this fractional value is different than that for the DES exposures.